

OSTEOTOMY OF THE FIRST METATARSAL BASE ON THE TREATMENT OF MODERATE TO SEVERE HALLUX VALGUS RESULTS AFTER MEAN FOLLOW-UP TIME OF EIGHT YEARS

Marco Túlio Costa¹, Roberto Zambelli de Almeida Pinto², Ricardo Cardenuto Ferreira¹, Minoru Alessandro Sakata¹, Gastão Guilherme Frizzo¹, Roberto Atílio Lima Santin³

ABSTRACT

Objective: To assess the result of the treatment of moderate to severe hallux valgus with osteotomy of the first metatarsal base associated to distal release of soft parts and medial capsuloplasty. **Methods:** 13 patients were assessed (15 feet) submitted to surgical treatment of hallux valgus moderate to severe. The mean follow-up time was 102 months; there were 12 female and 1 male patients, with mean age at the time of surgery of 49 years. The patients enrolled were interviewed according to the questionnaire developed by our service, clinically examined according to the AOFAS scale and submitted to X-ray tests for comparing the results with baseline images. **Results:** The mean score of the AOFAS scale obtained at the final assessment was 82 points. Nine of the 15 feet (60%) showed some late complications, with four (27%) varus deformities, three (20%) recurrences; two patients (13%) presenting with pain complaints with no

associated deformity. In the hallux metatarsophalangeal joint, movement loss was 41° (57%); dorsiflexion movement was mostly affected, with a mean loss of 37° (60%). The range of motion on the contralateral intact side served as control group. Arthrosis progression was seen on the final X-ray evaluation. In all cases, shortening and lifting of the first metatarsal were noticed; however, we couldn't correlate the shortening and lifting with metatarsalgia, plant callosity or lower scoring on the AOFAS scale at the final evaluation. **Conclusions:** The osteotomy technique by the basis and with distal realignment of soft parts employed in the treatment of moderate to severe hallux valgus showed a high rate of late complications. Due to the high number of complications, we believe that adopting this technique for correcting hallux valgus deformities should be carefully considered.

Keywords – Hallux valgus; Metatarsophalangeal joint; Metatarsal bones; Surgery; Osteotomy; Follow-up studies

INTRODUCTION

Proximal osteotomies of the first metatarsal, associated with distal soft tissue release, have been described as a treatment option for moderate and severe hallux valgus⁽¹⁻³⁾. Some authors emphasize the capacity for angle correction and positioning of the sesamoids as the main advantage of this type of surgical approach^(1,4,5). However, others have documented difficulties in maintaining the anatomy of the first metatarsal, and difficulty in the fixation of the osteotomy, which could lead to malunion with elevation of the first metatarsal⁽⁶⁻⁹⁾. In addition, a tendency towards changes in the patterns of plantar pressure in patients undergoing proximal

osteotomy of the first metatarsal, leading to transfer metatarsalgia, would be a possible complication of the procedure^(6,8) due to a possible shortening and elevation of the first metatarsal.

The incidence of complications in this approach is relatively high, especially hallux varus and recurrence of the deformity^(5,8). Another very noticeable but poorly documented complication in clinical practice is the restriction of movement of the metatarsophalangeal joint of the first ray⁽¹⁾.

The aim of this study is to evaluate the results of moderate to severe hallux valgus correction with osteotomy of the base of the first metatarsal, associated

1 – Assistant Physician, Foot and Ankle Group, Santa Casa de Misericórdia de São Paulo, Brazil.

2 – Physician, Former Intern of the Foot and Ankle Group, Santa Casa de Misericórdia de São Paulo, Brazil.

3 – Physician, Head, Foot and Ankle Group, Santa Casa de Misericórdia de São Paulo, Brazil.

Study conducted at the Department of Orthopedics and Traumatology, “Fernandinho Simonsen” Pavilion, School of Medical Sciences, Santa Casa de Misericórdia de São Paulo. Correspondence: Rua João Moura, 2245 – São Paulo, SP. CEP: 05412-004. E-mail: tulioim@uol.com.br

We declare no conflict of interest in this article

with distal soft tissue release and medial capsuloplasty.

Our hypothesis is that this combination of procedures would lead to a high incidence of first ray elevation, with a consequent increase in injuries due to load transfer to the lateral rays, culminating with clinical and functional deterioration of the patients in the long-term.

METHODS

Thirteen patients (15 feet) were included in this study with a diagnosis of moderate or severe symptomatic hallux valgus according to the Coughlin classification⁽³⁾, who underwent osteotomy of the base of the first metatarsal, distal soft tissue release, and medial capsuloplasty, operated by the Foot and Ankle Group, Santa Casa de Misericórdia de São Paulo. Exclusion criteria were patients with a diagnosis of rheumatoid arthritis and juvenile hallux valgus, in addition to those who underwent previous surgeries on the same foot. Deformities with an intermetatarsal angle between 11° and 16° and metatarsophalangeal angle between 20° and 40° were considered moderate according to the criteria defined by Coughlin⁽³⁾, and

severe those with an intermetatarsal angle greater than 16° and metatarsophalangeal angle greater than 40°.

The mean follow-up period was 102 months (range 26 to 202 months). Twelve patients were female and one was male. The average age at the time of surgery was 49 years (range 19 to 76 years).

The osteotomy used to correct the deformity was the lateral wedge removal in nine feet (60%), proximal chevron in five feet (33%) and proximal crescentic on one foot (7%). Fixation was performed with wires in 12 feet (80%) and screws in three feet (20%) (Table 1).

The following operations were performed concurrently: realignment of the metatarsophalangeal joint of the third toe on two feet for the treatment of dorsal subluxation of the proximal phalanx; arthrodesis of the proximal interphalangeal joint of the second toe on four feet for correction of a rigid claw toe deformity; medial displacement osteotomy of the calcaneus on one foot for the treatment of excessive valgus deformity of the hindfoot; transfer of the long flexor tendon of the second toe to the extensor complex on one foot for the correction of flexible claw toe deformity; and lengthening of the hallux long extensor tendon on one foot.

Table 1 – Distribution of patients evaluated with respect to age (in years), gender, type of osteotomy and fixation, early and late complications, residual pain, range of motion in the MTP of the hallux, the AOFAS scale score for the hallux MTP, and personal satisfaction with the results.

Case	Age	Gender	Deformity	Type of osteotomy	Fixation	Early comp.	Late comp.	Residual pain	Hallux MTP Mobility		AOFAS	Satisfaction
									Plantar flexion	Dorsiflexion		
1	48	F	Severe	Lateral wedge	1 K wire		Hallux varus	Moderate – head II and III MTT	20	20	52	Unsatisfied
2	44	F	Severe	Proximal crescentic	1 K wire			Mild – head II and III MTT	30	30	85	Satisfied
3	53	F	Severe	Lateral wedge	1 K wire			No	0	20	73	Satisfied with minimal restrictions
4	19	F	Severe	Lateral wedge	2 K wires			No	30	30	95	Satisfied
5	76	F	Severe	Lateral wedge	1 K wire			No	0	30	95	Satisfied
6	57	F	Moderate	Lateral wedge	1 cortical screw 3.5 mm		Hallux varus	Mild – head II, III and IV MTT	45	35	75	Unsatisfied
6'		F	Severe	Lateral wedge	1 cortical screw 3.5 mm		Hallux varus	No	50	35	75	Unsatisfied
7	63	M	Severe	Lateral wedge	2 K wires			No	20	10	95	Satisfied
8	44	F	Moderate	Lateral wedge	1 cannulated screw 4.0 mm		Hallux varus	Moderate – head II and III MTT	20	20	45	Satisfied with greater restrictions
9	59	F	Severe	Chevron	2 K wires			No	30	10	95	Satisfied
10	25	F	Severe	Chevron	2 K wires	Superficial infection	Recurrence	Mild – MTP hallux	30	50	73	Unsatisfied
11	59	F	Severe	Chevron	1 K wire		Recurrence	No	20	20	90	Satisfied with greater restrictions
12	68	F	Severe	Lateral wedge	2 K wires			No	45	30	100	Satisfied
13	25	F	Severe	Chevron	2 K wires		Recurrence	No	60	15	88	Satisfied with minimal restrictions
13'		F	Severe	Chevron	3 K wires			No	60	15	95	Satisfied with minimal restrictions

F: female; M: male; K: Kirschner; MTT: metatarsal; MTP: metatarsophalangeal; Comp: complications. Lateral wedge: osteotomy with removal of the lateral wedge at the base of the first metatarsal. Source: SAME, Santa Casa de Misericórdia de São Paulo

Clinical and functional evaluation

Patients were asked about the presence or absence of forefoot pain, deformity, limitations in daily living, walking capacity and maximum distance travelled, as well as satisfaction with the outcome of the surgical procedure. The American Orthopaedic Foot and Ankle Society (AOFAS)⁽¹⁰⁾ functional scale was used to quantitatively measure postoperative results for the hallux metatarsophalangeal joint.

The clinical examination noted the alignment and position of the foot for support, the presence or absence of hallux deformities (valgus, varus, flexion, or extension), and changes in other toes (claw or hammer). Then, with the patient sitting on the examination table, we assessed the presence of calluses or sensory changes (areas of hypoesthesia or the presence of neuromas) and the range of motion of the ankle, subtalar, midfoot, and metatarsophalangeal (MTP) joints of the hallux. Since we did not include joint mobility in the preoperative examination of all patients, we used the patients' unoperated feet as the control group. Patients who underwent surgery on both feet were excluded from the control group.

Radiographic evaluation

The preoperative dorsoplantar and profile radiographs of the forefoot were performed with load-bearing. These radiographs were compared with the first postoperative load-bearing radiographs about 12 weeks after surgery and also with those made at the time of the last clinical functional evaluation.

The radiographic parameters used for evaluation and comparison were:

Intermetatarsal angle I-II⁽³⁾ (IMA I-II): angle between the lines that bisect the diaphysis of the first and the second metatarsal (MTT);

Hallux valgus angle⁽³⁾ (HVA): angle between the lines that bisect the diaphysis of the proximal phalanx and the first metatarsal;

Position of the sesamoids, according to the classification of Smith and Reynolds⁽⁷⁾, using as reference the position of the tibial sesamoid in relation to the longitudinal axis of the first MTT, where grade 0 is normal, that is, the tibial sesamoid is the medial axis; in grade 1 there is less than 50% overlap; in grade 2, overlap is greater than 50% and in grade 3, lateral deviation;

Distal metatarsal articular angle⁽³⁾ (DMAA): determines the most lateral point and the most medial point of the distal articular surface of the first MTT; a

line is drawn connecting the two points. Next, a line is drawn in the axis of the first MTT and the angle between the two lines is measured;

Arthritis of the metatarsophalangeal (MTP) joint of the hallux, Hattrup and Johnson's classification⁽¹⁾, grade 0 is considered normal; grade 1 is characterized by the presence of mild to moderate osteophytes; grade 2, moderate osteophytes, with reduced joint space and sclerosis; and grade 3, osteophytes associated with significant reduction in joint space, with or without the presence of cysts. For these data, we used only the preoperative and the final postoperative radiographs;

Elevation of the first metatarsal⁽⁶⁾: a reference line is drawn between the most plantar point of the calcaneal tuberosity and the most plantar point of the head of the fifth MTT. Next, a line is drawn perpendicular to the previous line to the most plantar point of the head of the first MTT (d). This distance "d" is equivalent to the elevation of the first MTT (Figure 1).

Shortening of the first metatarsal⁽¹¹⁾: a line is drawn on the long axis of the first MTT from the most distal point to the most proximal point (A), the same is done for the second MTT (B). The shortening is measured by the difference between A and B. Negative values correspond to index minus and positive values to index plus (Figure 2).

For the statistical evaluation of data, paired or independent t-tests were used for the data that had normal distribution, and the Mann-Whitney and Wilcoxon tests for those that did not have normal distributions. Values with $p < 0.05$ were considered statistically significant. To establish correlation between shortening, elevation, and evaluation by the AOFAS scale, we used the correlation coefficient (r), the analysis of which is shown in Chart 1.



Figure 1 – Radiographic image illustrating the method of measurement of the first MTT elevation from the ground.



Figure 2 – Radiographic image illustrating the measurement of the first MTP shortening in relation to the second, where the value is expressed as the difference A-B.

Chart 1 – Correlation coefficient (r) parameters of analysis.

< 0.25	No or weak correlation
0.25 – 0.5	Small correlation
0.5 – 0.75	Fair to good correlation
> 0.75	Good to excellent correlation
Positive values: direct correlation	Negative values: indirect correlation

RESULTS

All patients were evaluated by the same examiner who was not involved at any time during treatment. As for the AOFAS score, the mean value obtained in the final evaluation was 82 points (range 45 to 100 points).

We observed superficial infection in the operative wound in one foot, which developed early with recurrence of the deformity. In this case, we performed proximal chevron osteotomy fixed with 2.0 mm Kirschner wires. We observed early arthritis of the metatarsophalangeal joint in one foot treated with arthrodesis. Symptomatic varus deformity of the hallux were late complications in four feet (three patients). All of these cases had undergone osteotomy with lateral wedge removal; in three, fixation was performed with screws. Although the three patients (four feet) complained of the deformity, a second corrective surgery (arthrodesis of the hallux metatarsophalangeal joint) was only performed in two feet. Recurrence of deformity occurred in three patients (three feet) who had undergone proximal chevron osteotomy; however, all refused further surgery. No delayed union or pseudarthrosis was observed.

On clinical examination, we noted pain on the medial aspect of the MTP joint of the hallux in five patients (five feet). Three of these had varus deformity of the hallux. Pain in the MTP of the hallux was not related to recurrence of valgus deformity. Three of the five patients with pain had undergone osteotomy with removal of the lateral wedge at the base of the first metatarsal. Plantar calluses were present in four feet, located in the head of the second and/or third metatarsal. However, only two were symptomatic. Table 1 shows the general data of the patients.

Assessing the range of motion of the joints of the foot and ankle, we observed no significant changes with respect to the ankle and subtalar joint, and mobility of the midfoot (pronation/supination, adduction/abduction). There was loss of movement in the MTP joint of the hallux in 13 of the 15 feet, which averaged 41° (57% loss in relation to the control group). Dorsiflexion movement was the most affected, with a loss of 37° on average (60% loss in relation to the control group).

Of the 13 patients evaluated, only six reported being completely satisfied with the outcome of treatment in the final evaluation. Two (three feet) stated they were satisfied, however, with minimal restrictions, and two others were satisfied with greater restrictions. Three patients (four feet) were dissatisfied with the final results (two of these with hallux varus and another with recurrence of the deformity) (Table 1).

The results of the radiographic evaluation are shown in Table 2. When the statistical analysis of the values was performed, we observed that only the DMAA did not change.

We compared the clinical and functional results according to the AOFAS scale for the MTP joint of the hallux with the shortening and the elevation observed in the radiographic examination (Table 3). However, there was no statistical correlation between these variables (Table 4).

When comparing the presence or absence of pain in the MTP joint of the hallux in the final postoperative evaluation with loss of motion in dorsiflexion, we also did not observe any statistical correlation.

Observed shortening and elevation of the first metatarsal in all cases. However, there was no statistically significant correlation between the elevation and shortening of the first metatarsal with the presence of plantar calluses or lower scores on the AOFAS scale for the MTP joint of the hallux.

Table 2 – Radiographic evaluation of patients diagnosed with hallux valgus treated with proximal osteotomy of the first MTT and distal soft tissue release.

	Preop. (mean)	Initial postop. (mean)	Final postop. (mean)	
HVA	35° (18 - 47)	14° (-2 - 36)	9° (-40 - 46)	p < 0.0001**
IMA I-II	17° (15 - 22)	9° (0 - 20)	8° (0 - 20)	p < 0.0001**
DMAA	10° (4 - 20)	13° (8 - 22)	11° (4 - 22)	p = 0.47
Arthritis*	1 (0 - 2)		2 (1 - 3)	p < 0.0001**
Sesamoids*	4 (3 - 4)		2 (1 - 4)	p < 0.0001**
Elevation	0.77cm (0 - 1.3)	1.31cm (0 - 2.3)	1.30cm (0.8 - 2.0)	p < 0.0001**
Shortening	-1.29cm (1.0 - 1.7)	-1.70cm (1.1 - 2.2)	-1.73cm (0.9 - 2.3)	p < 0.0001**

HVA: hallux valgus angle, IMA I-II: I-II MTT intermetatarsal angle; DMAA: distal metatarsal articular angle.

*Value expressed by the median of the values obtained. Statistical evaluation of preoperative and final postoperative data. **Statistically significant (p < 0.05).

Source: SAME, Santa Casa de Misericórdia de São Paulo.

Table 3 – Distribution of patients in relation to the type of osteotomy, AOFAS scale score for hallux MTP, shortening and elevation of the first metatarsal, pre- and postoperative hallux valgus angles, angle between the first metatarsal and the second metatarsal, and classification of osteoarthritis in the initial and final radiographs according to Harttrup and Johnson.

Foot	Type of osteotomy	AOFAS	Shortening (cm)	Elevation (cm)	HVA pre	HVA final	MTT 1-2 pre	MTT 1-2 final	Initial hallux MTP arthritis	Final hallux MTP arthritis
1	Lateral wedge R	52	0.60	1.00	18.00	-42.00	18.00	0.00	1.00	2.00
2	Proximal crescentic R	85	0.70	0.60	34.00	18.00	16.00	10.00	1.00	2.00
3	Lateral wedge	73	0.50	1.00	37.00	16.00	17.00	8.00	0.00	1.00
4	Lateral wedge L	95	0.20	0.40	40.00	14.00	17.00	6.00	0.00	3.00
5	Lateral wedge R	95	0.30	0.70	45.00	28.00	16.00	6.00	1.00	1.00
6	Lateral wedge R	75	0.30	0.30	25.00	5.00	15.00	8.00	1.00	1.00
6'	Lateral wedge L	75	0.40	1.10	32.00	-4.00	17.00	7.00	2.00	3.00
7	Lateral wedge L	95	0.20	0.20	47.00	12.00	22.00	6.00	2.00	2.00
8	Lateral wedge R	45	0.30	0.40	33.00	-20.00	16.00	6.00	2.00	2.00
9	Proximal chevron R	95	0.30	0.60	30.00	18.00	15.00	12.00	1.00	1.00
10	Proximal chevron L	73	0.70	0.10	40.00	46.00	18.00	20.00	0.00	2.00
11	Proximal chevron R	90	0.30	0.60	44.00	20.00	16.00	10.00	1.00	2.00
12	Lateral wedge R	100	0.60	0.80	32.00	7.00	17.00	9.00	1.00	2.00
13	Proximal chevron R	88	0.70	0.10	28.00	32.00	16.00	18.00	0.00	1.00
13'	Proximal chevron L	95	0.80	0.20	30.00	6.00	16.00	6.00	0.00	1.00

R: Right, L: left; HVA: hallux valgus angle; MTP: metatarsophalangeal. Negative hallux valgus angle values indicate varus deformity.

Source: SAME, Santa Casa de Misericórdia de São Paulo.

Table 4 – Details of the shortening and the elevation of the first ray from the second ray of patients with hallux valgus treated with proximal osteotomy of the first MTT.

Name	AOFAS (points)	Shortening (cm)	Elevation (cm)
ANB	52	0.60	1.00
EC	85	0.70	0.60
IR	73	0.50	1.00
SLD	95	0.20	0.40
MMD	95	0.30	0.70
EJJ	75	0.30	0.30
EJJ"	75	0.40	1.10
NDF	95	0.20	0.20
TPM	45	0.30	0.40
JRSF	95	0.30	0.60
SRO	73	0.70	0.10
SIS	90	0.30	0.60
ANS	100	0.60	0.80
MCAG	88	0.70	0.10
MCAG"	95	0.80	0.20

Correlation coefficient (r) Elevation x AOFAS = -0.0495

Correlation coefficient (r) Shortening x AOFAS = -0.2097

AOFAS: American Orthopaedic Foot and Ankle Society score for the hallux metatarsophalangeal joint.

Source: SAME, Santa Casa de Misericórdia de São Paulo.

DISCUSSION

Osteotomies of the base of the first metatarsal, whether lateral base wedge⁽⁸⁾, medial addition wedge^(12,13), proximal chevron^(9,13) or proximal crescentic osteotomy^(1,2,7,14), always associated with distal realignment procedures with release of the lateral capsule and adjoining tendon have been described for the correction of moderate to severe hallux valgus. However, some authors have noted that this technique can lead to elevation and/or shortening of the first metatarsal^(4-6,14), with subsequent long-term clinical and functional deterioration due to the emergence of the calluses and transfer metatarsalgia. In the Brazilian literature, we found no equivalent follow-up (mean of eight years) in cases of base osteotomy for the correction of moderate to severe hallux valgus deformity.

With a mean follow-up of eight years, the mean AOFAS score of the patients was 82 points (range 45

to 100). The factors that contributed most to the loss of points were mobility of the MTP joint of the hallux (13 of the 15 feet had limited mobility) and pain (five of 15 feet had pain in the final evaluation). Baykal et al.⁽¹⁵⁾ observed an improvement from 54.4 to 95.4 points and no pain complaints in 93.8% of the feet; however, the mean follow-up was 28 months. Okuda et al.⁽¹⁾ showed similar results, with an average final AOFAS score of 92 points, but also had a maximum follow-up period of three years, which was less than the period observed in our study. Brodsky et al.⁽⁴⁾ found an average final AOFAS score of 86.4 points (range 71 to 100) in a study in which 32 patients were followed for an average period of 29 months. Despite the AOFAS scale score reported by these authors being higher than the scores of the patients evaluated in this study, the follow-up period was also shorter. This allows us to question whether the functional clinical outcome measured by the AOFAS scale would deteriorate with increasing time of follow-up.

The restriction of movement in the hallux MTP occurred mainly in dorsiflexion, with a limitation of more than 50% of mobility (37° on average). Okuda et al.⁽²⁾ found a loss of only 7° dorsiflexion and 15° plantar flexion, with a mean follow-up of 48 months, using pre- and postoperative measurement as the parameters. In our study, we used the contralateral foot as the control parameter. Okuda et al.⁽¹⁾, with a maximum follow-up period of three years, reported a loss of 21° for any movement of the hallux MTP, also utilizing the preoperative evaluation as a parameter. In our opinion, the excessive tension of the joint capsule, poor reduction of the joint, and the presence of arthritis can be causes of movement restriction. We observed that the greatest loss of joint mobility occurred in dorsiflexion. The elevation of the first metatarsal, that is, the dorsal angulation at the osteotomy site, observed in all our patients, may also be a cause of this restriction of movement.

Some authors have emphasized the possibility of correcting the HVA, IMA I-II, and the position of the sesamoids with proximal osteotomy with a distal soft tissue procedure^(1-4,7,8). However, we must consider that varus deviation of the hallux, a complication observed in four patients (27%) in our study, and demonstrated by negative angle values, enhances the corrective power of this technique. In the patients who evolved with varus in the hallux MTP, the average HVA value was -15.3°. When we exclude these patients from the final HVA average, the average value

of this angle was 19.7°, which shows incomplete correction of the deformity. In relation to IMA I-II in patients with hallux varus, the average was 5.3°, and in the others, 10.1°. Therefore, when we discard the cases that progressed with varus deformity of the hallux MTP, we note that the ability of this technique is not as great as initially observed.

The presence of arthritis was also a very significant finding. In ten feet (66%) evaluated in this study, there was osteoarthritis progression in the hallux MTP. No joint was rated as zero on the radiographs obtained in the final evaluation. Okuda et al.⁽¹⁾ demonstrated that even in an interval of only three years, arthritis may already be present, though sometimes asymptomatic, in the MTP joint of the hallux. We believe that excessive tension of the capsule in the region of the hallux MTP joint, poor reduction of this joint after surgery, and undiagnosed prior joint damage may be the cause of the onset and progression of radiographic osteoarthritis. Although asymptomatic in some cases, the presence of osteoarthritis in the MTP of the hallux may be responsible for the loss of mobility observed postoperatively. We must remember that the base osteotomy is indicated in cases of moderate to severe hallux valgus, which may have joint degeneration before surgical correction.

Osteotomies of the base of the first metatarsal to correct varus of the first ray cause changes in the alignment, and, in addition to elevation and/or shortening, depression, stretching, or rotation may occur⁽¹³⁾. The shortening and elevation may be related to the presence of injury by transfer to the lateral rays (calluses)⁽⁶⁻⁸⁾. The evaluation of the shortening of the first metatarsal can be performed from various formulas described in the literature^(3,4,6). However, they all have their difficulties in reproducibility due to factors such as the position of the foot or the bulb of the X-ray machine during the test. We believe that the method we have adopted minimizes these variations, because it uses the second metatarsal as a parameter.

Nyska et al.⁽⁵⁾, in an experiment with bone models, performed a wide variety of proximal osteotomies of the first metatarsal, observing minimal elevation and rotation in all of the techniques used. In another study⁽⁶⁾, the authors observed an average shortening of 1.4 mm and an average elevation of 2 mm; 38% of the feet showed an elevation greater than 2 mm, however, without a statistically significant correlation between these residual deformities and the occurrence or worsening of transfer injuries. Mann et al.⁽¹⁶⁾ observed

28% elevation of the first ray after proximal crescentic osteotomies, much higher than the 9% found by Zettl et al.⁽⁹⁾, who viewed the elevation as a limitation of the technique, which is associated with the occurrence of transfer injuries. In an evaluation of 42 feet, Trnka et al.⁽⁸⁾ noticed an average shortening of 0.5 cm and dorsal deviation of the first metatarsal in 15 feet (25%). In our study, although an average elevation of 0.52 cm and an average shortening of 0.44 cm showed statistical significance, there was no positive statistical correlation between painful plantar calluses and transfer injuries with the shortening and elevation of the first metatarsal (calluses were observed in four feet, and only two were symptomatic).

Veri et al.⁽⁷⁾ noted 5% varus deformities, 11% recurrence and 2% of new lesions by load transfer. In addition, they observed that most of the new pain complaints in the forefoot were located in the MTP joint, the majority (60%) of them related to hallux varus. In a retrospective study of 114 feet, Zettl et al.⁽⁹⁾ observed evolution to hallux varus in 9% of the feet, two feet developed hallux rigidus, and only one relapse. Trnka et al.⁽⁸⁾ found 17% poor clinical outcomes

as to the aesthetics of the first ray when considering the patient's subjective evaluation. When reporting late complications, the authors cited 27% varus deformities (16 of 60 feet), attributing this deformity to excessive removal of the bunion, excessive correction of IMA I-II, and capsuloplasty with excessive tension. Although there has been no standardization of the procedures performed in the patients evaluated in this study (different osteotomy and fixation techniques), we consider the rate of late complications as high, that is, nine of 15 feet (60%) with a late complication, of which four (27%) were varus deformities, three (20%) cases of recurrence, and two (13%) were complaints of pain without any associated deformity.

CONCLUSIONS

Osteotomy of the base and distal soft tissue realignment used to correct moderate to severe hallux valgus showed a high rate of late complications. Due to the high number of complications, we believe that this technique should be considered with caution for correction of hallux valgus.

REFERENCES

- Okuda R, Kinoshita M, Morikawa J, Jotoku T, Abe M. Distal soft tissue procedure and proximal metatarsal osteotomy in hallux valgus. *Clin Orthop Relat Res.* 2000;(379):209-17.
- Okuda R, Kinoshita M, Morikawa J, Jotoku T, Abe M. Proximal metatarsal osteotomy: relation between 1-to greater than 3-years results. *Clin Orthop Relat Res.* 2005;(435):191-6.
- Coughlin MJ. Hallux Valgus. *J Bone Joint Surg Am.* 1996;78(6):932-66.
- Brodsky JW, Beischer AD, Robinson AH, Westra S, Negrine JP, Shabat S. Surgery for hallux valgus with proximal crescentic osteotomy causes variable postoperative pressure patterns. *Clin Orthop Relat Res.* 2006;(443):280-6.
- Nyska M, Trnka HJ, Parks BG, Myerson MS: Proximal metatarsal osteotomies: A comparative geometric analysis conducted on sawbone models. *Foot Ankle Int.* 2002; 23(10):938-45.
- Bozkurt M, Tigar C, Dalstra M, Jensen NC, Linde F. Stability of a cannulated screw versus a Kirschner wire for the proximal crescentic osteotomy of the first metatarsal: a biomechanical study. *J Foot Ankle Surg.* 2004;43(3):138-43.
- Veri JP, Pirani SP, Claridge R. Crescentic proximal osteotomy for moderate to severe hallux valgus: a mean 12,2 year follow-up study. *Foot Ankle Int.* 2001;22(10): 817-22.
- Trnka HJ, Mühlbauer M, Zembsch A, Hungerford M, Ritschl P, Salzer M. Basal closing wedge osteotomy for correction of hallux valgus and metatarsus primus varus: 10- to 22-year follow-up. *Foot Ankle Int.* 1999;20(3):171-7.
- Zettl R, Trnka HJ, Easley M, Salzer M, Ritschl P. Moderate to severe hallux valgus deformity: correction with proximal crescentic osteotomy and distal soft tissue release. *Arch Orthop Trauma Surg.* 2000;120(7):397-402.
- Kitaoka HB, Alexander IJ, Adelaar RS, Nunley JA, Myerson MS, Sanders M. Clinical rating systems for the ankle and hindfoot, midfoot, halux, and lesser toes. *Foot Ankle Int.* 1994;15(7):349-52.
- Roukis TS, Jacobs PM, Dawson DM, Erdmann BB, Ringstrom JB. A prospective comparison of clinical, radiographic, and intraoperative features of hallux rigidus. *J Foot Ankle Surg.* 2002;41(2):76-95.
- Ignácio H, Chueire AG, Carvalho Filho G, Nascimento LV, Vasconcelos UMR, Barão GTF. Estudo retrospectivo da osteotomia de base do primeiro metatarsal como tratamento do hálux valgo. *Acta Ortop Bras.* 2006; 14(1):48-52.
- Ruaro AF, Carvalho Junior AE, Fernandes TD, Salomão O, Aguiar JAG, Meyer AT. Estudo comparativo entre duas técnicas de osteotomia no tratamento do hálux valgo: análise clínica e radiográfica. *Rev Bras Ortop.* 2000;35(7):248-59.
- Dreeben S, Mann RA: Advanced hallux valgus deformity. Long-term results utilizing the distal soft tissue procedure and proximal metatarsal osteotomy. *Foot Ankle Int.* 1996;17(3):142-4.
- Baykal B, Kirdemir V, Atesalp AS, Bek D, Tercan V. Modified crescentic metatarsal osteotomy and distal soft tissue procedures in hallux valgus. *Mil Med.* 2006; 171(12):1247-50.
- Mann RA, Rudicel S, Graves SC. Repair of hallux valgus with a distal soft tissue procedure and proximal metatarsal osteotomy. A long-term follow-up. *J Bone Joint Surg Am.* 1992;74(1):124-9.